

CLAIMS

- 1 1. A method for locating symbols arranged in one or
2 more rows in an image, the method comprising:
3 smearing the image;
4 fitting line segments through edge points of
5 features in the smeared image;
6 finding a group of the line segments in mutual
7 proximity that are mutually substantially parallel; and
8 identifying a region of the image that contains the
9 group of the line segments as a possible location of the
10 symbols.
- 1 2. A method according to claim 1, and comprising
2 binarizing the image before smearing it.
- 1 3. A method according to claim 2, wherein binarizing
2 the image comprises applying selective binarization so as
3 to preserve in the binarized image the features of the
4 image that have stroke widths in a predetermined range
5 that is associated with the symbols.
- 1 4. A method according to claim 1, wherein smearing the
2 image comprises applying a morphological expansion
3 operator to the features in the image.
- 1 5. A method according to claim 4, wherein applying the
2 expansion operator comprises expanding the features in a
3 plurality of different directions, and selecting one of
4 the directions so as to minimize a number of runs of
5 consecutive pixels in the smeared image.
- 1 6. A method according to claim 5, wherein fitting the
2 line segments through the edge points comprises fitting
3 the segments through end points of the runs.

- 1 7. A method according to claim 1, wherein fitting the
- 2 line segments comprises applying a Hough transform to the
- 3 edge points.
- 1 8. A method according to claim 1, wherein fitting the
- 2 line segments comprises determining skew angles of the
- 3 rows of symbols based on orientations of the line
- 4 segments.
- 1 9. A method according to claim 1, wherein finding the
- 2 group of the line segments comprises selecting the line
- 3 segments for inclusion in the group based on numbers of
- 4 the edge points that are located on each of the selected
- 5 line segments.
- 1 10. A method according to claim 1, wherein finding the
- 2 group of the line segments comprises finding end points
- 3 of the line segments, and selecting the line segments for
- 4 inclusion in the group whose end points are within a
- 5 predetermined range of one another.
- 1 11. A method according to claim 1, wherein identifying
- 2 the region comprises selecting a plurality of regions
- 3 containing respective groups of the line segments at
- 4 different skew angles.
- 1 12. A computer-implemented method for reading characters
- 2 arranged in one or more rows on an object, comprising:
 - 3 capturing an image of the object;
 - 4 smearing the image;
 - 5 fitting line segments through edge points of
 - 6 features in the smeared image;
 - 7 finding a group of the line segments in mutual
 - 8 proximity that are mutually substantially parallel;

9 identifying a region of the image that contains the
10 group of the line segments as a location of the rows of
11 the characters; and

12 applying optical character recognition to read the
13 characters in the region.

1 13. A method according to claim 12, wherein the object
2 comprises a parcel, and wherein the one or more rows of
3 the characters comprise address information for the
4 parcel.

1 14. A method according to claim 13, and comprising
2 sorting the parcel responsive to the address information.

1 15. Apparatus for locating symbols arranged in one or
2 more rows in an image, comprising an image processor,
3 which is arranged to smear the image, to fit line
4 segments through edge points of features in the smeared
5 image, to find a group of the line segments in mutual
6 proximity that are mutually substantially parallel, and
7 to identify a region of the image that contains the group
8 of the line segments as a possible location of the
9 symbols.

1 16. Apparatus according to claim 15, wherein the image
2 processor is arranged to binarize the image before
3 smearing it.

1 17. Apparatus according to claim 16, wherein the
2 processor is arranged to binarize the image by applying
3 selective binarization so as to preserve in the binarized
4 image the features of the image that have stroke widths
5 in a predetermined range that is associated with the
6 symbols.

1 18. Apparatus according to claim 15, wherein the
2 processor is arranged to smear the image by applying a
3 morphological expansion operator to the features in the
4 image.

1 19. Apparatus according to claim 18, wherein the
2 processor is arranged to expand the features in a
3 plurality of different directions, and to select one of
4 the directions so as to minimize a number of runs of
5 consecutive pixels in the smeared image.

1 20. Apparatus according to claim 19, wherein the
2 processor is arranged to fit the line segments through
3 end points of the runs.

1 21. Apparatus according to claim 15, wherein the
2 processor is arranged to fit the line segments by
3 applying a Hough transform to the edge points.

1 22. Apparatus according to claim 15, wherein the
2 processor is arranged to determine skew angles of the
3 rows of symbols based on orientations of the line
4 segments.

1 23. Apparatus according to claim 15, wherein the
2 processor is arranged to select the line segments for
3 inclusion in the group based on numbers of the edge
4 points that are located on each of the selected line
5 segments.

1 24. Apparatus according to claim 15, wherein the
2 processor is arranged to find end points of the line
3 segments, and to select the line segments for inclusion
4 in the group whose end points are within a predetermined
5 range of one another.

1 25. Apparatus according to claim 15, wherein the
2 processor is arranged to select a plurality of regions
3 containing respective groups of the line segments at
4 different skew angles.

1 26. Apparatus for reading characters arranged in one or
2 more rows on an object, comprising:

3 an image capture device, arranged to capture an
4 image of the object; and

5 an image processor, which is arranged to smear the
6 image, to fit line segments through edge points of
7 features in the smeared image, to find a group of the
8 line segments in mutual proximity that are mutually
9 substantially parallel, to identify a region of the image
10 that contains the group of the line segments as a
11 location of the rows of the characters, and to apply
12 optical character recognition to read the characters in
13 the region.

1 27. Apparatus according to claim 26, wherein the object
2 comprises a parcel, and wherein the one or more rows of
3 the characters comprise address information for the
4 parcel.

1 28. Apparatus according to claim 27, and comprising a
2 sorting device, which is arranged to sort the parcel
3 responsive to the address information.

1 29. A computer software product for locating symbols
2 arranged in one or more rows in an image, the product
3 comprising a computer-readable medium in which program
4 instructions are stored, which instructions, when read by
5 a computer, cause the computer to smear the image, to fit
6 line segments through edge points of features in the

7 smeared image, to find a group of the line segments in
8 mutual proximity that are mutually substantially
9 parallel, and to identify a region of the image that
10 contains the group of the line segments as a possible
11 location of the symbols.

1 30. A product according to claim 29, wherein the
2 instructions cause the computer to binarize the image
3 before smearing it.

1 31. A product according to claim 30, wherein the
2 instructions cause the computer to binarize the image by
3 applying selective binarization so as to preserve in the
4 binarized image the features of the image that have
5 stroke widths in a predetermined range that is associated
6 with the symbols.

1 32. A product according to claim 29, wherein the
2 instructions cause the computer to smear the image by
3 applying a morphological expansion operator to the
4 features in the image.

1 33. A product according to claim 32, wherein the
2 instructions cause the computer to expand the features in
3 a plurality of different directions, and to select one of
4 the directions so as to minimize a number of runs of
5 consecutive pixels in the smeared image.

1 34. A product according to claim 33, wherein the
2 instructions cause the computer to fit the line segments
3 through end points of the runs.

1 35. A product according to claim 29, wherein the
2 instructions cause the computer to fit the line segments
3 by applying a Hough transform to the edge points.

1 36. A product according to claim 29, wherein the
2 instructions cause the computer to determine skew angles
3 of the rows of symbols based on orientations of the line
4 segments.

1 37. A product according to claim 29, wherein the
2 instructions cause the computer to select the line
3 segments for inclusion in the group based on numbers of
4 the edge points that are located on each of the selected
5 line segments.

1 38. A product according to claim 29, wherein the
2 instructions cause the computer to find end points of the
3 line segments, and to select the line segments for
4 inclusion in the group whose end points are within a
5 predetermined range of one another.

1 39. A product according to claim 29, wherein the
2 instructions cause the computer to select a plurality of
3 regions containing respective groups of the line segments
4 at different skew angles.

1 40. A product according to claim 29, wherein the symbols
2 comprise characters, and wherein the instructions cause
3 the computer to apply optical character recognition to
4 read the characters in the identified region.

1 41. A product according to claim 40, wherein the image
2 comprises a parcel, and wherein the one or more rows of
3 the symbols comprise address information for the parcel.

1 42. A product according to claim 41, wherein the
2 instructions cause the computer to sort the parcel
3 responsive to the address information.